

UNITED STATES MARINE CORPS

LESSON PLAN

WEIGHT

INTRODUCTION:

1. Gain Attention. Why does an anchor sink but a boat will stay afloat?
2. Overview. During this period of instruction we will define weight and explain it's variables and introduce buoyancy and the Archimedes Principle.
3. Introduce Learning Objectives.
 - a. Terminal Learning Objective. With the aid of, and in accordance with the references, define and explain the variable relationships of weight.
 - b. Enabling Learning Objective(s). Without the aid of, but in accordance with the references, define and explain:
 - (1) Weight.
 - (2) Buoyancy force.
 - (3) Archimedes Principle.
4. Method/Media. This period of instruction will be taught using the lecture method with the aid of QMMCBT-001 "Introduction to the Dynamics of the Atmosphere".
5. Evaluation. You will not be evaluated, however there will be a question and answer session at the end of this period of instruction.

TRANSITION. Have you ever wondered how you can weigh 200 pounds on earth but be weightless in space, you haven't gone on a Jenny Craig diet, how is this possible?

BODY:

1. Define weight.
 - a. Weight. Weight is a type of force defined using a specific acceleration (due to gravity). In other words weight is a measure of the force of gravity on a body. Because the weights of different bodies at the same location are proportional to their masses, weight is often used to determine mass. However the two are not the same; mass is a measure of the amount of matter present in a body and thus has the same value at different locations, and weight varies dependent upon the location of the body in the Earth's gravitational field. For example, if an object weighed 5 kilograms on earth but was weightless on the moon, it would still have the same amount of mass. As meteorologists we use the metric

system for weight there for we will use grams or kilograms when discussing weight, but as Americans we also will use ounces and pounds, so it is imperative that you know the conversions between these two units. (Refer to QMMPH1-001 Meteorological Conversions) For purposes in the course we will assume gravity to be constant, where "g" is gravity, $g = 9.8 \text{ m/s}^2$. The equation for weight then is "w" (weight) = "m" (mass) times "g" (gravity) or $W=mg$.

TRANSITION. When looking at two objects the same size quite often you would assume that they are the same weight or close to the same weight. Well what if your two objects are a volleyball and a bowling ball, they are clearly the same size but the bowling ball could weigh up to 100 times that of the volleyball. Why is this, it is the same gravity acting on the two, they are roughly the same size, could it be what is inside of them, or their mass?

2. Variable Relationships of Weight. The equation for weight is $W = mg$, since in this course gravity is assumed to be constant the only variable for weight is mass. It is real simple, if the mass increases the weight increases and if the mass decreases the weight decreases.

$$\uparrow w = \uparrow m \ g \quad \downarrow w = \downarrow m \ g$$

TRANSITION. Have you ever wondered how a billion ton cruise liner stays afloat while at sea, why it's sheer weight doesn't make it sink? Or how a hot air balloon stays airborne?

3. Archimedes Principle. To understand the Archimedes Principle you must first understand buoyancy force.

a. Buoyancy is the upward force exerted on an object immersed in a fluid. Of course, water is the most common fluid, but buoyancy also applies to hot air balloons (where the fluid is the surrounding air) and many other situations.

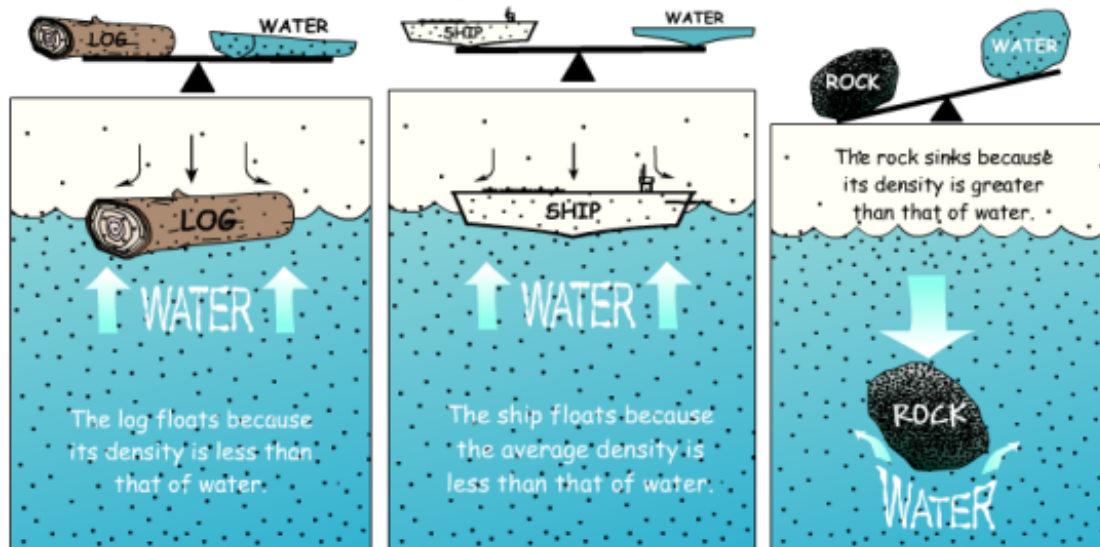


Figure 1 - Demonstration of buoyancy.

b. Archimedes Principle states that a body immersed in a fluid is buoyed up by a force equal to the weight of the displaced fluid. The principle applies to both floating and submerged bodies and to all fluids. The weight of an object acts downward, and the buoyant force provided by the displaced fluid acts upward. If these two forces are equal, the object floats. Density is defined as weight per volume. If the density of an object exceeds the density of water, the object will sink.

OPPORTUNITY FOR QUESTIONS:

1. Questions from the Class. At this time are there any questions from the class pertaining to the material that has just been presented?

2. Questions to the Class.

QUESTION. What is the only variable for weight?

ANSWER. Mass.

Question. Explain the Archimedes Principle.

Answer. Archimedes Principle states that a body immersed in a fluid is buoyed up by a force equal to the weight of the displaced fluid.

SUMMARY: This period of instruction enabled you to define weight and understand the variable relationships associated with it and introduced the Archimedes Principle explaining how hot air balloons rise and how ships float

REFERENCE.

Lutgens, Frederick K. and Tarbuck, Edward J. The Atmosphere, An Introduction to Meteorology. 9th edition. Pearson Education Inc. 2004

Columbia University press, The Columbia Encyclopedia, Sixth Edition 2001-2004

Glickman, Todd S. Glossary of Meteorology, 2nd Edition. American Meteorological Society, Boston Massachusetts, U.S.A.

Ahrens, Donald C. Meteorology Today. 4th Edition. West Publishing Company, 1991

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